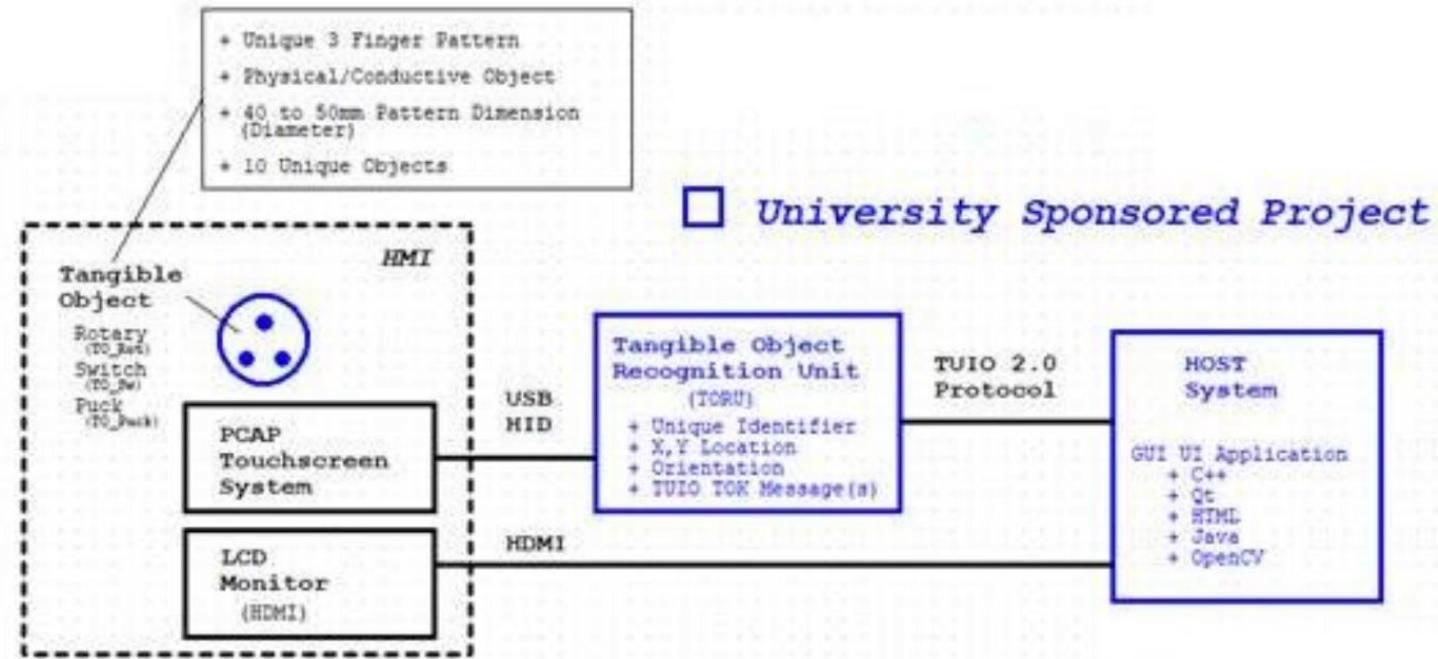




Tangible Object Touchscreen

Client: Mitch Butzer, Advanced Input system

Andrew Brown, Preyusha Aryal, Reilly Wolfe



Touchscreen Operation

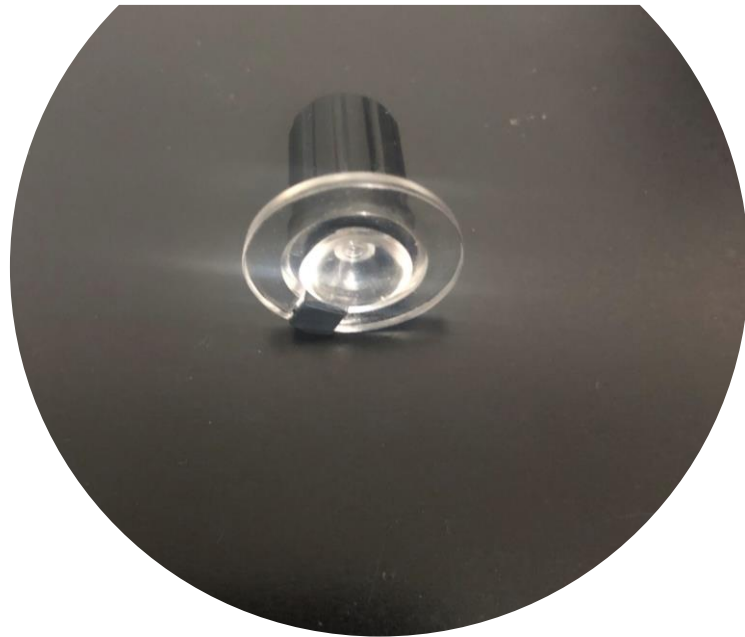
- Touchscreen Data output
- TUIO/TURO protocol
- GUI Host system
- Screen output

Objective

- Develop working GUI for touchscreen
 - Works with TUIO/TURO Protocol
- Working touchscreen with tangible object inputs
 - Knob, Switch, Joystick, Puck
 - Objects mount to screen
 - Object recognition

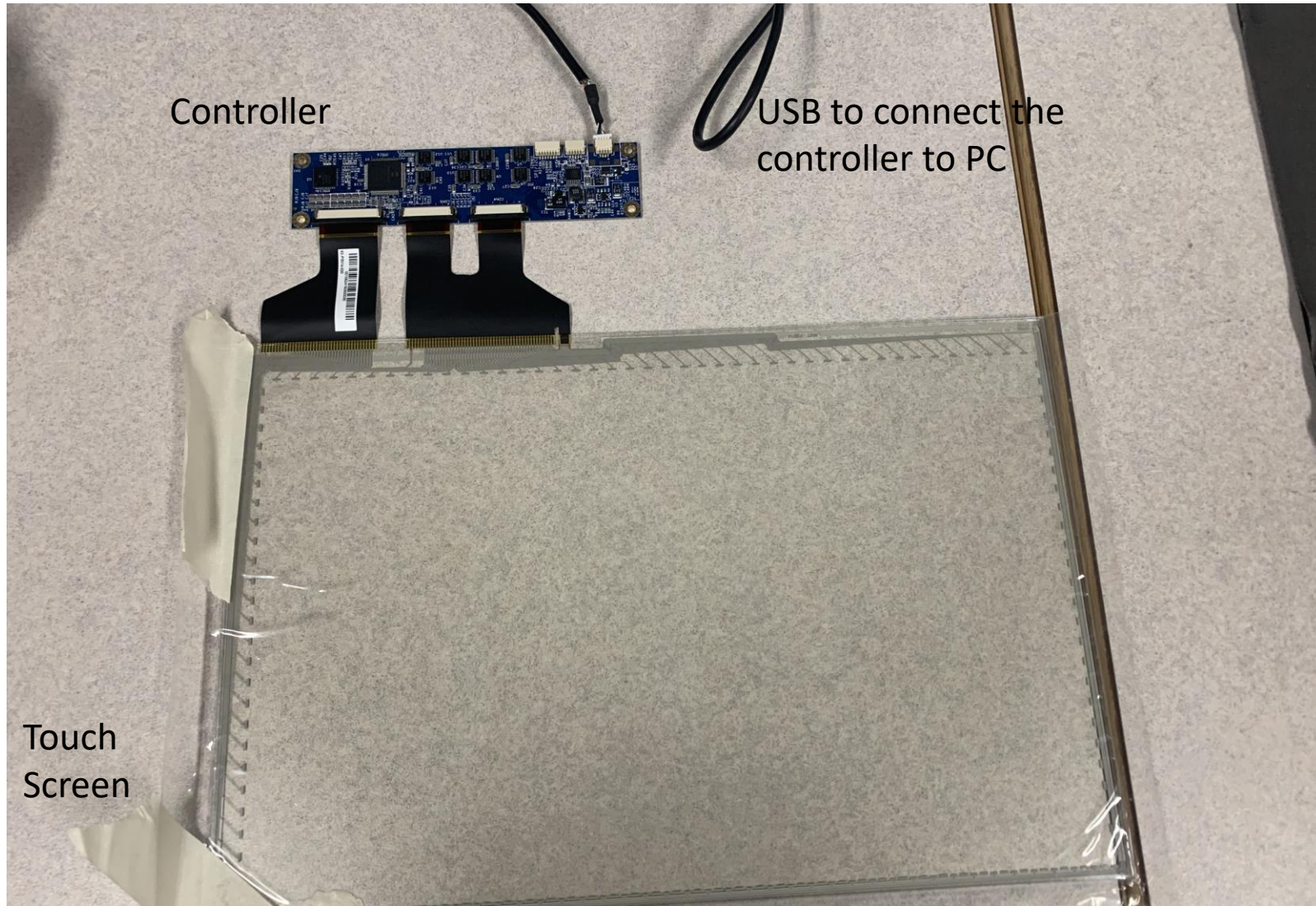


Inventory of Product Requirements



Blind Touch Feedback		
Joy Stick Feedback	Resistance	
Switch Feedback	Break Over	Rubber boot
Knob Feedback	Ticks	
Interface Requirements:		
Clearance to avoid scratching	TBD	
Object Touch Ergonomics	Per item basis	
P-CAP glass interface		
Appearance Requirements:		
Surface finish	TBD	
5 Mechanical Requirements:		
Strength Requirements:		
Object attachment (Horizontal Force)	10	lbs
Object attachment (Vertical Force)	10	lbs
Spatial Requirements:		
Object size	1-2	inches
Touch Screen size	12.1	inches
Adhesion Requirements:		
Maximum temperature	110	F
Minimum temperature	32	F
Blind Touch Feedback		
Joy Stick Feedback	Resistance	
Switch Feedback	Break Over	Rubber boot
Knob Feedback	Ticks	

Software: free USB analyzer and QT



Controller

USB to connect the controller to PC

Touch Screen

Touchscreen Data Analysis Setup

Touchscreen Raw Data

000207: Report Arrived (UP), 2020-10-08 16:18:24.1492161 +0.0069800

Report Name:Touch Screen

Report ID:-1

Unknown[0x0..0xf]: 0x0

Tip Switch: 1

In Range: 1

Unknown: 1

X[0..2047]: 1365

Y[0..2047]: 1285

000209: Report Arrived (UP), 2020-10-08 16:18:24.1572555 +0.0080259

Report Name:Touch Screen

Report ID:-1

000211: Report Arrived (UP), 2020-10-08 16:18:24.1702580 +0.0129807

Report Name:Touch Screen

Report ID:-1

Unknown[0x0..0xf]: 0x0

Tip Switch: 1

In Range: 1

Unknown: 1

X[0..2047]: 1365

Y[0..2047]: 1282

HMI VIEW

00000231	2020-10-08 16:22:05.9314131	+0.0090033	UP	0x00000000	URB_FUNCTION_BULK_OR_INTERRUPT_TRANSFER
00000233	2020-10-08 16:22:05.9364071	+0.0049828	UP	0x00000000	URB_FUNCTION_BULK_OR_INTERRUPT_TRANSFER
00000235	2020-10-08 16:22:05.9424250	+0.0060070	UP	0x00000000	URB_FUNCTION_BULK_OR_INTERRUPT_TRANSFER
00000237	2020-10-08 16:22:05.9524387	+0.0100014	UP	0x00000000	URB_FUNCTION_BULK_OR_INTERRUPT_TRANSFER
00000239	2020-10-08 16:22:05.9574163	+0.0049662	UP	0x00000000	URB_FUNCTION_BULK_OR_INTERRUPT_TRANSFER
00000241	2020-10-08 16:22:05.9634379	+0.0060093	UP	0x00000000	URB_FUNCTION_BULK_OR_INTERRUPT_TRANSFER
00000243	2020-10-08 16:22:05.9734422	+0.0099879	UP	0x00000000	URB_FUNCTION_BULK_OR_INTERRUPT_TRANSFER
00000245	2020-10-08 16:22:05.9794528	+0.0059939	UP	0x00000000	URB_FUNCTION_BULK_OR_INTERRUPT_TRANSFER
00000247	2020-10-08 16:22:05.9844402	+0.0049719	UP	0x00000000	URB_FUNCTION_BULK_OR_INTERRUPT_TRANSFER
00000249	2020-10-08 16:22:05.9944373	+0.0099859	UP	0x00000000	URB_FUNCTION_BULK_OR_INTERRUPT_TRANSFER
00000251	2020-10-08 16:22:05.9994408	+0.0049916	UP	0x00000000	URB_FUNCTION_BULK_OR_INTERRUPT_TRANSFER
00000253	2020-10-08 16:22:06.0234499	+0.0239981	UP	0x00000000	URB_FUNCTION_BULK_OR_INTERRUPT_TRANSFER
00000255	2020-10-08 16:22:06.0324141	+0.0089439	UP	0x00000000	URB_FUNCTION_BULK_OR_INTERRUPT_TRANSFER
00000257	2020-10-08 16:22:06.0424632	+0.0100372	UP	0x00000000	URB_FUNCTION_BULK_OR_INTERRUPT_TRANSFER
00000259	2020-10-08 16:22:06.0514653	+0.0089852	UP	0x00000000	URB_FUNCTION_BULK_OR_INTERRUPT_TRANSFER
00000261	2020-10-08 16:22:06.0604281	+0.0089462	UP	0x00000000	URB_FUNCTION_BULK_OR_INTERRUPT_TRANSFER
00000263	2020-10-08 16:22:06.0694302	+0.0089871	UP	0x00000000	URB_FUNCTION_BULK_OR_INTERRUPT_TRANSFER

Complete

000253: Bulk or Interrupt Transfer (UP), 2020-10-08 16:22:06.0234499 +0.0239981. (1. Device: PM1401) Status: 0x00C

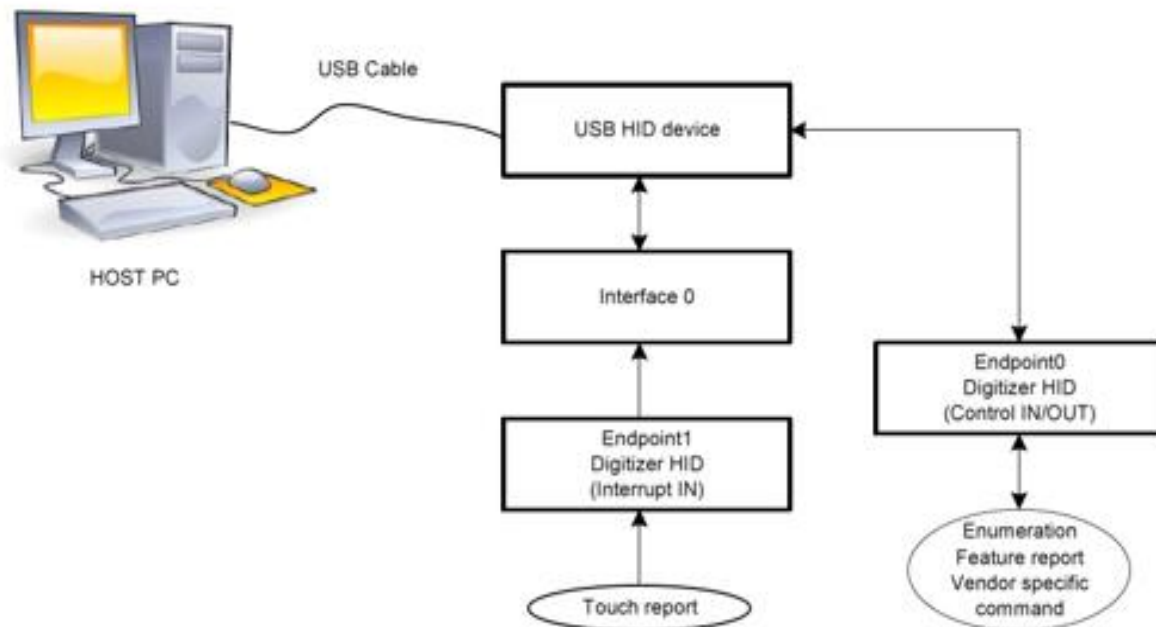
Pipe Handle: 0xccba63b8 (Endpoint Address: 0x81)

Get 0x5 bytes from the device

70 CB 03 2A 05

PACKET VIEW

Data Interpretation



	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
USB Report ID		Report ID (7:0)								
Touch Digitizer[A]	0	Touch ID (4:0)					Rsvd	Rsvd	Tip Switch	
Touch Digitizer[A]	1	Touch X coordinate(7:0)								
Touch Digitizer[A]	2	Touch X coordinate (15:8)								
Touch Digitizer[A]	3	Touch Y coordinate (7:0)								
Touch Digitizer[A]	4	Touch Y coordinate (15:8)								
Time stamp		Time stamp(7:0)								
Time stamp		Time stamp(15:8)								
Touch Count		Touch Count (7:0)								

	Usage	Values
Report ID	USB Communication with API	01h always
Tip Switch	Indicates lift-off of a finger	1 during touch 0 after releasing finger
Rsvd	reserved	0 always
Touch ID	Finger ID for finger trajectory formation	00h for invalid touch 01h..0Ah for valid touch
Touch X Coordinate	Touch X coordinates for operating system user event input control	0000h..7FFFh 0000h addresses the most left pixel column of the operating system desktop environment 7FFFh addresses the most right pixel column of the operating system desktop environment
Touch Y Coordinate	Touch Y coordinates for operating system user event input control	0000h..7FFFh 0000h: top most pixel row of the operating system desktop environment 7FFFh:bottom most pixel row of the operating system desktop environment
Time stamp	Scan Time High-Resolution time-stamp that is saved at the end of the multi-touch algorithm. Rollover from +65535 to 0. The scan time is in the physical unit of 0.1ms.	0000h..FFFFh
Touch Count	Number of reported touches in the report	00h...0Ah

Data Interpretation

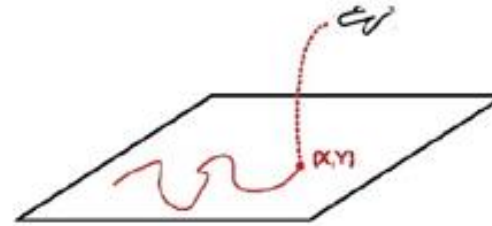
Physical Touch on TS



Event 1

Touch Report - Endpoint 1				
0x01	Xmsb	Xlsb	Ymsb	Ylsb
0x00	0x00	0x00	0x00	0x00
0x00	0x00	0x00	0x00	0x00
0x00	0x00	0x00	0x00	0x00
0x00	0x00	0x00	0x00	0x00
0x00	0x00	0x00	0x00	0x00
0x00	0x00	0x00	0x00	0x00
0x00	0x00	0x00	0x00	0x00
0x00	0x00	0x00	0x00	0x00
0x00	0x00	0x00	0x00	0x00
0x00	0x00	0x00	0x00	0x00
0x00	0x00	0x00	0x00	0x00
0x01				

1 - One down touch with tracking (in red) with the corresponding Touch report report with Tip Switch set (1)



Event 2

Touch Report - Endpoint 1				
0x01	Xmsb	Xlsb	Ymsb	Ylsb
0x08	0x00	0x00	0x00	0x00
0x00	0x00	0x00	0x00	0x00
0x00	0x00	0x00	0x00	0x00
0x00	0x00	0x00	0x00	0x00
0x00	0x00	0x00	0x00	0x00
0x00	0x00	0x00	0x00	0x00
0x00	0x00	0x00	0x00	0x00
0x00	0x00	0x00	0x00	0x00
0x00	0x00	0x00	0x00	0x00
0x00	0x00	0x00	0x00	0x00
0x00	0x00	0x00	0x00	0x00
0x00	0x00	0x00	0x00	0x00
0x00	0x00	0x00	0x00	0x00
0x01				

Event 2 - Finger is lifted, no touches are detected by the cc. The controller copies the previous touch report (before before lift) and sets the Tip Switch to 0 (cl)

Data Interpretation

Project Milestone

Approval of Requirements	10/1/2020
Concept Design Review	11/30/2020
Detailed Design Review	2/9/2021
Complete Prototype Build	4/5/2021
UI Design EXPO	4/26/2021
Final Reports and Drawings to client	5/4/2021